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A device for protection of electrical networks from surges of high voltage utilising spark gaps

Patent Number: GB2053579
Publication date: 1981-02-04
Inventor(s):
Applicant(s): POST OFFICE
Requested Patent: GB2053579
Application Number: GB19790022602 19790628
Priority Number(s): GB19790022602 19790628
IPC Classification: H01T3/00
EC Classification: H01T4/08, H05K1/02C6
Equivalents:

Abstract

Multiple gaps are provided by conductive fingers 1 to 8 connected to the main tracks 9 and 10 of a printed circuit. When a high voltage surge occurs across the main tracks 9 and 10, a spark will cross one of the gaps 11 to 14 and thus not damage the network itself. The fingers however do suffer damage. The preferred device shown is to provide continued protection without interruption of the main tracks, even when the fingers have been quite seriously damaged, by inclining the parallel fingers 1 to 8, and by connecting the fingers to the main tracks 9 and 10 via secondary tracks 19 and 20.

(12) UK Patent Application (19) GB (11) 2 053 579 A

(21) Application No 7922602
(22) Date of filing 28 Jun 1979
(43) Application published 4 Feb 1981
(51) INT CL³ H01T 3/00
(52) Domestic classification H1X 5X
(56) Documents cited
GB 1561490
GB 1532228
GB 1494021
GB 1385606
GB 1168598
GB 299847
(58) Field of search H1X
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(54) A device for protection of electrical networks from surges of high voltage utilising spark gaps

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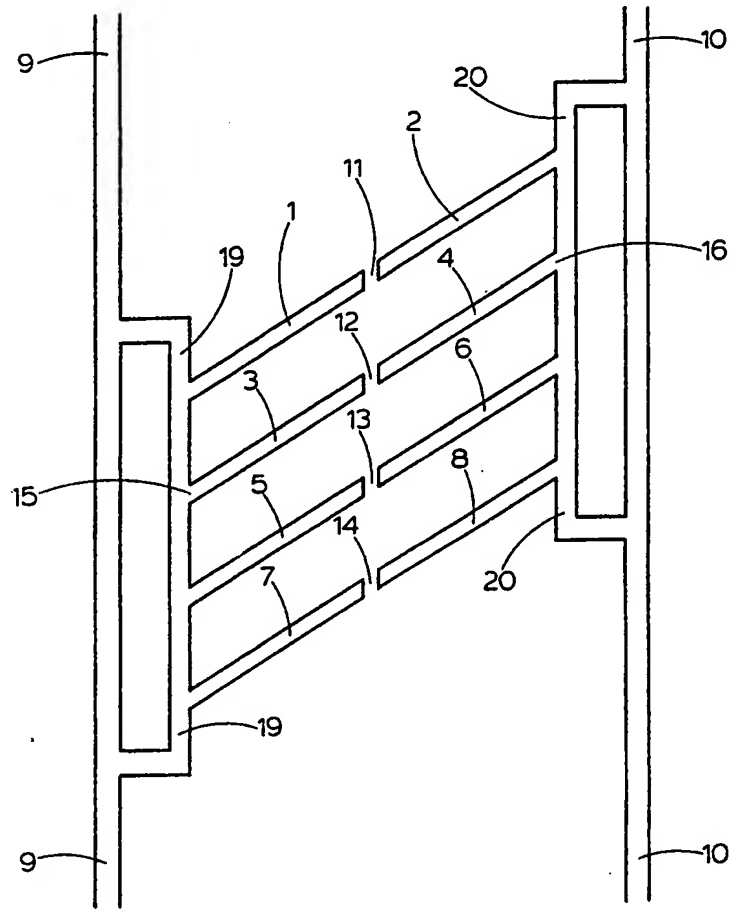
Fig.3



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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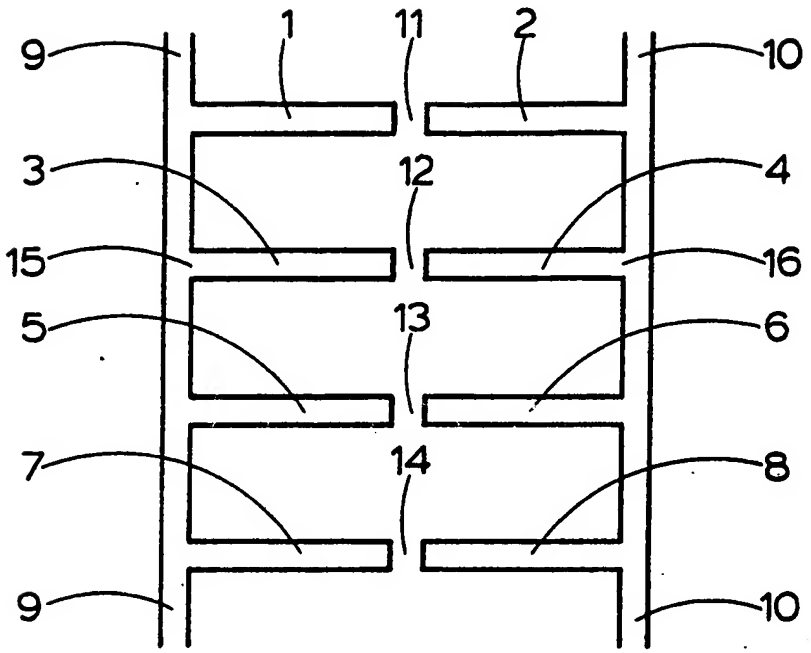
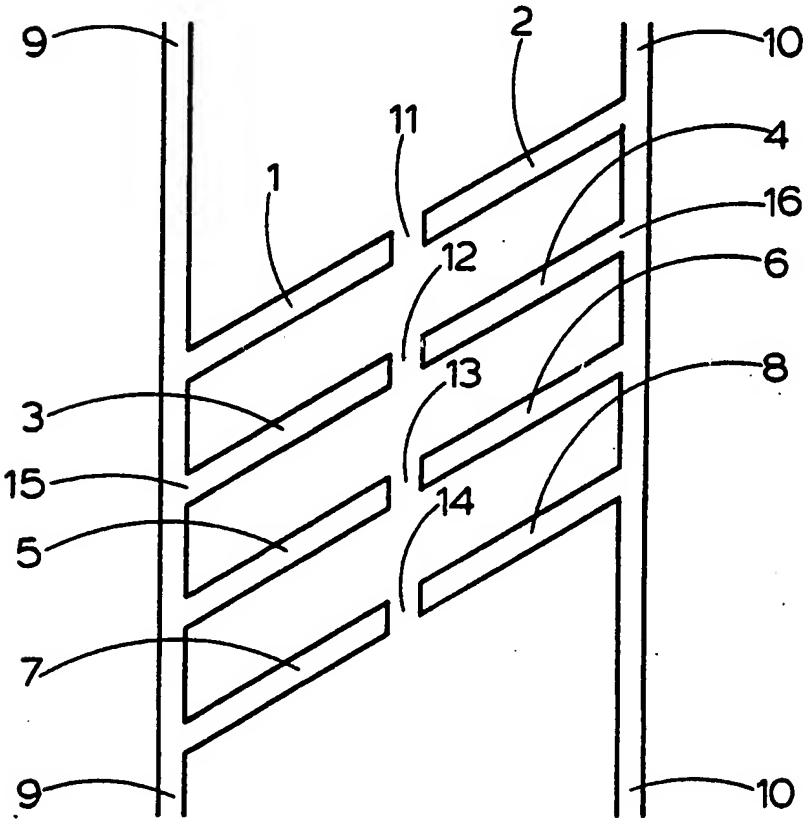

1
11
2
9
10
3
12
4
15
16
5
13
6
7
14
8
9
10

Fig.1


2
9
10
11
4
1
16
12
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13
8
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14
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7
9
10

Fig.2

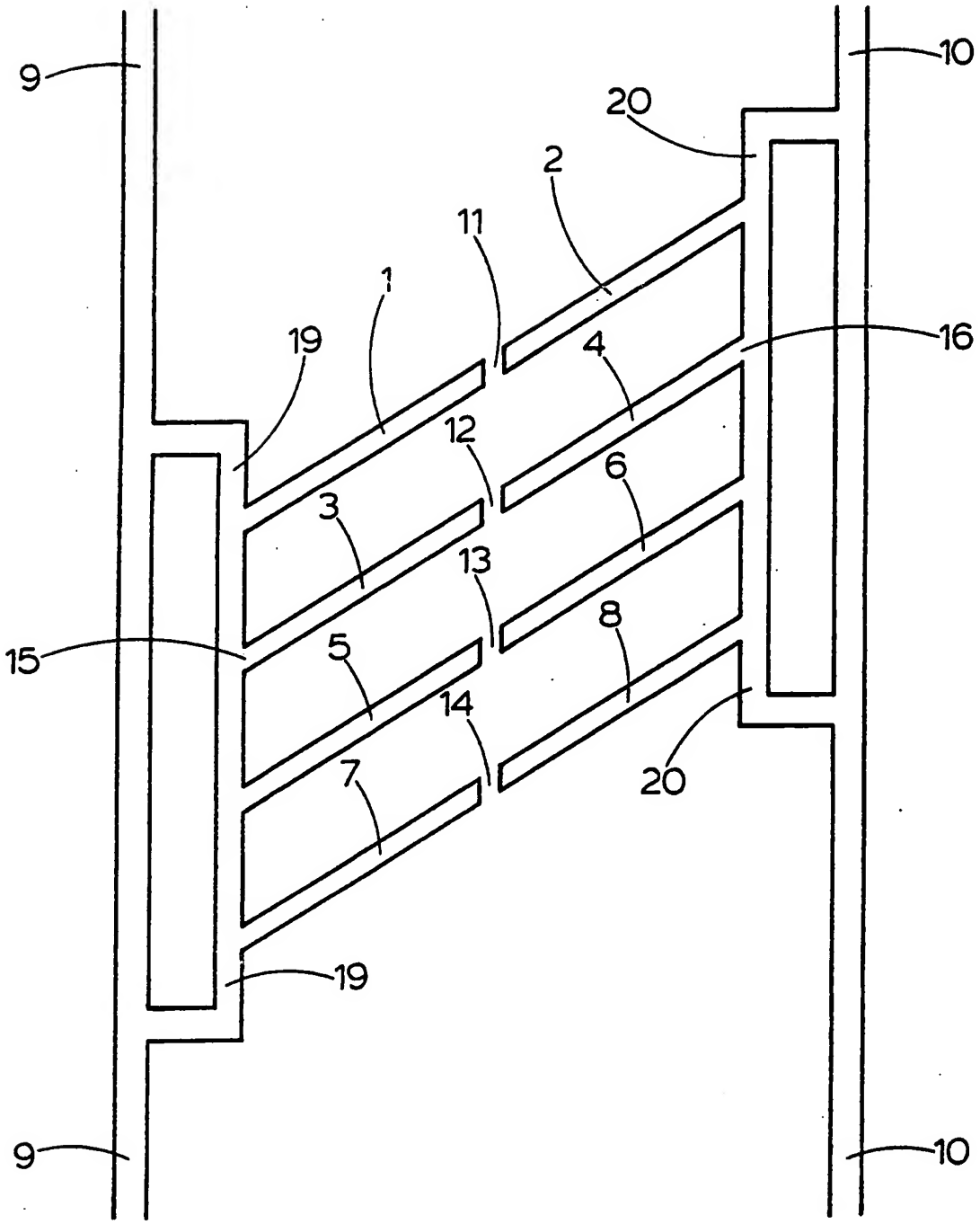

Fig.3

SPECIFICATION

Improvements in or relating to high voltage surge protection in electrical networks

The invention relates to improvements in the design of spark gaps for protecting electrical networks, particularly those networks on printed circuit boards.

An electrical network designed to operate with signals of a particular magnitude may be damaged by a signal substantially in excess of that magnitude. For example, the electrical network within a domestic telephone instrument may be damaged if the wires connecting the instrument to the exchange are struck by lightning. To protect a network from such a voltage surge it is known to add, at that port of the network connected to the telephone line a spark gap, so that a high voltage surge on the line will cause a spark across the gap which will dissipate energy at the gap and not cause damage to the network. When the network is to be manufactured on a printed circuit board, it is convenient to form the gap as an addition to the printed circuit. It is usual for the gap to be formed between the tips of a pair of fingers of conductive track, each finger connected to one of the main tracks connecting the network to the line. When a voltage surge causes a spark to occur at such a gap, the spark will usually start at the tips of the fingers, it may burn away the ends of the fingers and grow in length. For very high energy voltage surges the spark may even burn away the fingers completely together with their points of connection with the main tracks.

Even if protection has been adequate against a first voltage surge, damage to the fingers forming the spark gap may have removed subsequent protection against future high voltage surges. The complete burning away of a finger, together with its point of contact with its main track, may even cause a break in the main track and disconnection of the network to be protected.

According to a first aspect of the present invention, there is provided a printed circuit having a pair of conductive tracks, said conductive tracks configured so that at least two gaps are formed between said conductive tracks having a separation substantially less than the separation of said conductive tracks at all other locations such that an arc is formed across at least one of said gaps when the electric potential between each conductive track of said pair exceeds a pre-determined value.

Preferably, said gaps may be formed between mutually proximate tips of pairs of conductive fingers, each finger formed integrally as a portion of one of said conductive tracks.

According to a second aspect of the present invention there is provided a printed circuit, having a high voltage surge protector formed integrally with a pattern of printed conductors comprising said printed circuit, said high voltage surge protector comprising at least two pairs of printed conductive fingers, each pair having mutually proximate tips defining gaps between said tips and a pair of printed conductive tracks, between which, an electrical potential may be generated by a voltage surge, one finger of each pair of fingers connected to one of said pair of printed conductive tracks, the other finger of each pair of fingers connected to the other of said pair of printed conductive tracks such that an arc is formed across at least one of said gaps when the electric potential between each printed conductive track exceeds a pre-determined value.

Preferably, each conductive finger may be inclined at an acute angle to said conductive tracks.

Preferably, said conductive fingers may be parallel.

Preferably, the track to which said fingers are connected may be a subsidiary conductive track connected at at least one point to said printed conductive track.

Preferably, said subsidiary track may be connected at at least two points to said printed conductive track.

An embodiment of the present invention will now be described by way of example with reference to the drawings in which:—

Figure 1 is a plan view of four spark gaps provided by eight fingers in accordance with the present invention.

Figure 2 shows spark gaps provided by fingers which are inclined at an acute angle to the main tracks and are parallel in accordance with the present invention.

Figure 3 shows inclined parallel fingers, each having duplicate connection to the main track in accordance with the present invention.

Referring firstly to Figure 1 an array of four gaps 11, 12, 13 and 14 are provided between the main conductive tracks, 9 and 10 of the printed circuit by the tips of the fingers 1 to 8. If a sufficiently high electrical potential difference exists between the main conductive tracks 9 and 10, then a spark or arc of electric current will occur at one of the gaps. If the potential difference is so high that the spark, occurring for example at the gap 12 causes serious burning of the tips of the fingers 3 and 4, then there still exist the gaps 11, 13 and 14 to protect against subsequent high potentials.

If an electrical potential difference exists between the main tracks, 9 and 10, that is so high that a spark across the tips of the fingers e.g. 3 and 4 is inadequate to dissipate all the energy of the voltage surge, then the spark may grow in size until it is arcing from the bases 15 and 16 of the two fingers 3 and 4.

Referring now to Figure 2, the fingers 1 to 8 can be seen to be inclined to the main tracks 9 and 10 at an acute angle and to be mutually parallel. The acute angle provides fingers of greater length than would otherwise be possible, thus enabling each finger to survive a longer period of burning. The magnitude of the angle is a design compromise between the difficulty of producing a small angle using printed circuit manufacturing techniques without allowing sparking to the main tracks and the desirability of

a small angle to maximise the finger length. Having established the preferable angle the fingers 1 to 8 should be parallel rather than in herringbone pattern so that a spark required to dissipate maximum energy can grow to the greater size from the point 15 to the point 16 of Figure 2.

Should such a high energy voltage surge be generated and the bases 15 and 16 of the fingers, 3 and 4 be burned away, then not only are the fingers 3 and 4 destroyed, but the continuity of one of the main tracks 9 or 10 may also be destroyed.

Referring now to Figure 3, the multiple inclined parallel fingers, 1 to 8 of Figure 2 can be seen to be connected to subsidiary tracks, 19 and 20. If a high energy voltage surge does burn away the base, e.g. 15 of one of the fingers, 3 thereby destroying continuity of the subsidiary track 19, the main track 9 is not interrupted and the other fingers 1, 5 and 7 remain connected to it.

The device of Figure 3 therefore, incorporates the desirable features of multiple gaps, 11, 12, 13 and 14 provided by the tips of pairs of inclined, parallel fingers 1 to 8 connected to the main conducting tracks, 9 and 10 of printed circuit by subsidiary printed conducting tracks, 19 and 20.

It will be appreciated that whilst this technique of forming multiple spark gaps as part of a printed circuit applies predominently to printed circuit boards, it is also applicable to the printed artwork techniques used in integrated electronic circuitry.

CLAIMS

1. A printed circuit having a pair of conductive tracks, said conductive tracks configured so that at least two gaps are formed between said conductive tracks having a separation substantially less than the separation of said conductive tracks at all other locations such that an arc is formed across at least one of said gaps when the electric potential between each conductive track of said pair exceeds a predetermined value.

2. A printed circuit as claimed in claim 1 wherein said gaps are formed between mutually proximate tips of pairs of conductive fingers, each finger formed integrally as a portion of one of said conductive tracks.

3. A printed circuit having a high voltage surge protector formed integrally with a pattern of printed conductors comprising said printed circuit, said high voltage surge protector comprising at least two pairs of printed conductive fingers, each pair having mutually proximate tips defining gaps between said tips and a pair of printed conductive tracks between which an electrical potential may be generated by a voltage surge, one finger of each pair of fingers connected to one of said pair of printed conductive tracks, the other finger of each pair of fingers connected to the other of said pair of printed conductive tracks, such that an arc is formed across at least one of said gaps when the electric potential between each printed conductive track exceeds a pre-determined value.

4. A printed circuit as claimed in either of claims 2 or 3 wherein each conductive finger is inclined at an acute angle to said conductive tracks.

5. A printed circuit as claimed in claim 4 wherein said conductive fingers are parallel.

6. A printed circuit as claimed in any of claims 2 to 5 wherein the track to which said fingers are connected is a subsidiary conductive track connected at at least one point of two said printed conductive track.

7. A printed circuit as claimed in claim 6 wherein said subsidiary track is connected at at least two points to said printed conductive track.

8. A printed circuit substantially as hereinbefore described with reference to the drawings.

9. A printed circuit substantially as hereinbefore described with reference to Figure 1.

10. A printed circuit substantially as hereinbefore described with reference to Figure 2.

11. A printed circuit substantially as hereinbefore described with reference to Figure 3.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.